

## Claims

1. A microfluidic device for solid phase extraction of nucleic acids from samples, said microfluidic device comprising  
a body structure provided with a microchannel and an inlet port and an outlet port,  
5 wherein said inlet port and outlet port are formed on an exterior surface of said body structure and are in fluid communication with said microchannel, said microchannel having an interior surface and a first and second end; and  
a sol-gel matrix that spans a cross sectional dimension of the microchannel.
- 10 2. The microfluidic device of claim 1 wherein the sol-gel matrix further comprises silica particles.
3. The microfluidic device of claim 1 or 2 wherein the device further comprises a reaction chamber in fluid communication with the microchannel and the  
15 outlet port.
4. The microfluidic device of claim 1 wherein the sol-gel matrix is prepared using tetramethoxy orthosilicate monomers.
- 20 5. The microfluidic device of claim 1 or 2 wherein the sol-gel matrix comprises pores having a diameter selected from the range of about 0.1  $\mu\text{m}$  to about 10  $\mu\text{m}$ .
6. The microfluidic device of claim 5 wherein the average diameter of the  
25 sol-gel matrix pores is about 1  $\mu\text{m}$  to about 5  $\mu\text{m}$ .
7. The microfluidic device of claim 5 wherein the sol-gel matrix is bound to the interior surface of the microchannel.
- 30 8. The microfluidic device of claim 7 wherein the sol-gel matrix fills the microchannel from the first end to the second end.

9. A method of extracting nucleic acids from a biological sample said method comprising

contacting said sample with a chaotropic agent;

loading the sample onto a microcolumn under conditions conducive for nucleic  
5 acid binding to the column, wherein said column comprises a sol-gel matrix having a  
cross sectional dimension ranging from about 50  $\mu\text{m}^2$  to about 100  $\mu\text{m}^2$ ;

washing the matrix with a solvent; and

releasing the bound nucleic acid from the column.

10 10. The method of claim 9 wherein the sol-gel matrix has a cross sectional  
dimension ranging from about 24  $\mu\text{m}^2$  to about 100  $\mu\text{m}^2$ .

11. The method of claim 10 wherein the nucleic acid is DNA.

15 12. The method of claim 10 wherein the sol-gel matrix comprises pores having  
a diameter selected from the range of about 0.1  $\mu\text{m}$  to about 10  $\mu\text{m}$ .

13. The method of claim 9 wherein the nucleic acid is released from the  
column by washing with a buffer that is compatible with PCR reactions

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14. A nucleic acid processing system comprising

a base provided with a first and second microchannel, said first and second  
microchannels each having an interior surface and a first and second end;

a first port formed on an exterior surface of said base and in fluid communication  
25 with the first end of said first microchannel;

a second port formed on an exterior surface of said base and in fluid  
communication with both the second end of the first microchannel and the first end of the  
second microchannel;

a third port formed on an exterior surface of said base and in fluid communication  
30 with the second end of said second microchannel; and

a sol-gel matrix that spans a cross sectional dimension of the first microchannel.

15. The nucleic acid processing system of claim 14 wherein the base further comprises a reaction chamber in fluid communication with the first and second microchannel and the second port.

5 16. The nucleic acid processing system of claim 14 wherein the first, second and third ports are each formed on the same exterior surface of the base.

17. The nucleic acid processing system of claim 14 wherein said device further comprises pumping means in communication with said reaction chamber to  
10 regulate fluid flow to and from the reaction chamber.

18. The nucleic acid processing system of claim 14 wherein said device further comprises pumping means in communication with the first and second microchannels that regulates fluid flow through the first and second microchannels.

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19. The nucleic acid processing system of claim 18 wherein the wherein the sol-gel matrix comprises pores having a diameter selected from the range of about 0.1  $\mu\text{m}$  to about 10  $\mu\text{m}$ .

20 20. The nucleic acid processing system of claim 19 wherein the sol-gel matrix is bound to the interior surface of the first microchannel.

21. The nucleic acid processing system of claim 18 wherein said second microchannel is provided with reagents for analyzing nucleic acids.

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22. The nucleic acid processing system of claim 18 wherein the base is a microfluidic device.

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